Convert The Pye A200 For 6m Use

Modifying Pye gear isn't just about retuning transmitters to amateur frequencies, it's also about boosting your signals on 2, 4 and especially 6m for as little as £15 as Chris Lorek, G4HCL, explains.

Wandering around the surplus Pye gear at rallies — there were six stands with them at Drayton Manor this year — one sometimes sees the A200 on sale. It is often covered in dirt, as it is used as a 'stick it in the boot and forget it' add-on linear amplifier. People turn their noses up at them and walk away, not realising that even past professional radiotelephones could sometimes do with a few extra watts for maximum range.

Improvements in base station receiver design coupled with the ever increasing need for spectrum re-usage has meant that more of these units are finding their way onto the amateur market. Last year at an East Anglian rally, a large pile of these were offered for sale by one trader, but many were left unsold because people were very wary of what was inside them. Well inside these sturdy weatherproof boxes you will find a piece of mint-looking board with a 50W plus linear amplifier, complete with automatic RF sensing and changeover switching! Just the job for 2m, 4m, or — with some modes — 6m.

Identifying The Beast

This is very easy once you know what you're looking for, the only similar looking beast around has the same outer case but with two thick DC leads coming out of the side — this is a type VR200 24V to 12V converter. The most common amplifier has a single thick DC cable together with a coax socket mounted on either side of the cable exit, although you may sometimes find a later model, with one SO239 output socket and flying coax lead for the RF input. Internally they are virtually the same, but you may find the newer arrangement easier to install.

The DC cable is actually a very heavy current AC one with brown, blue, and green/yellow leads; brown is used as the positive 13.8V supply, blue as negative, and green/yellow as a switching lead. Please **don't** wire it up to your mains plug — the capacitors make a lovely exploding noise!

On the side of the case, you will find a riveted plate with "Cat No. A200" marked, below this is space for the aligned frequency of operation. Unfortunately this is often blank, but if you look at the section marked "Code", you will see something like "01 E0", which instantly gives you all the information you need. The first two numbers are the market code which is irrelevant for our purposes, the final letter/number combination gives the frequency range: E0=68–88 MHz, M1=105–108 MHz, B0=132–156 MHz, and A0=148–174 MHz. The E0 is useful for 4m, and both the B0 and A0 models will tune to 2m. 6m buffs should look for an E0 model.

Inside the E0 model are a pair of MPX085P or BLW60 transistor. These have forward bias applied via a wirewound resistor and two forward biased diodes. The RF path involves input and output printed circuit inductors, compression trimmers and a three stage low pass filter. A further capacitor and plate resistor on the input form a gain control to ensure the amplifier is operating in the linear portion of its input/output curve. RF sensing circuitry detects input drive and switches in the amplifier if DC power is supplied. The unit is extremely rugged both physically and electrically, and even incorporates an over-temperature cutout to stop the transistors overheating in use.

6m Modifications

Many amateurs are coming onto 6m with gear such as the FT690 or IC505, both reviewed in the May '86 issue. The output power of these, even with a reasonably large aerial system, will still not offer the legal maximum ERP on SSB. Commercially available transverters — such as the muTek and Microwave Modules units — give a greater power in general; even so an increase in power is always useful on initial CQ calls prior to final beam alignment.

At this stage I must point out that we should not use high power just for the sake of it. We are 'on trial' on 6m so remember to go back to

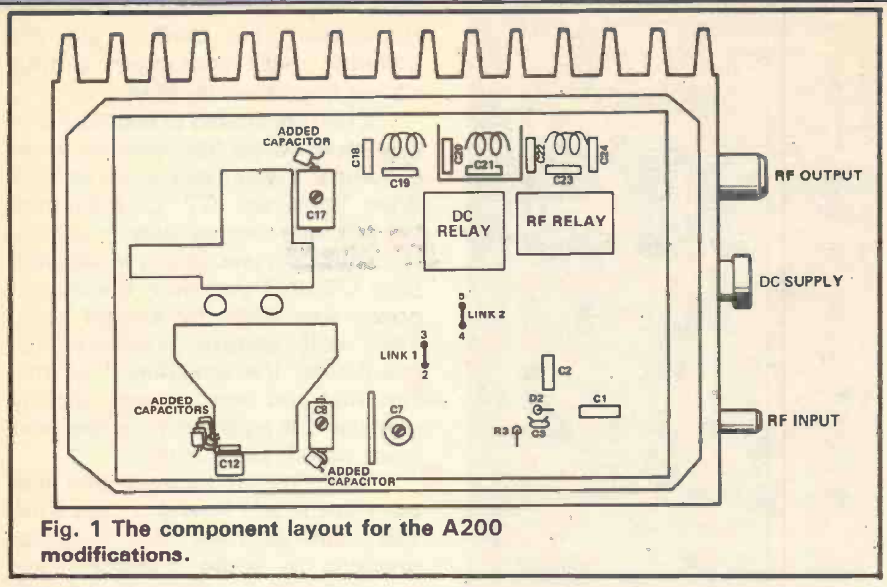


Fig. 1 The component layout for the A200 modifications.

low power when working your mate on the other side of town! Another problem is that of the second harmonic falling right in the middle of Band II broadcast frequencies. Many 50MHz sets fail in this respect and it could easily lead to a visit from the local RI man plus an angry neighbour deprived of £21.

The conversion was tackled in three stages, the low pass filter, then the amplifier itself, finally the switching circuitry.

Low Pass Filtering

Fig. 1 shows the layout of the unit. The low pass filter is made up in three sections and employs accurately made coils and tubular capacitors of close tolerance. It was decided to retain the original coils if possible and only modify capacitor values.

The existing filter was designed to pass 68-88MHz whilst attenuating the harmonics of these, which means that it probably would not offer too much rejection of 100MHz. A Hewlett Packard Network Analyser was used to check the attenuation and return loss characteristics of the existing filter circuit — the response being shown in **Fig. 2.** A set of capacitor values were calculated which would hopefully give the desired response, with maximum attenuation at 2nd harmonic and low loss of fundamental frequency. The network analyser was again connected to check that the response was just as required, see **Fig. 3.** Other units were modified with identical results.

Capacitor	Modification to be made
C8	Add 120pF across existing trimmer
C12	Add 750pF across, (see text)
C17	Add 68pF across
C18	Replace with 56pF
C19	Replace with 39pF
C20	Add 68pF across
C21	Replace with 18pF
C22	Add 68pF across
C23	Replace with 5.6pF
C24	Add 39pF across

Table 1 The component changes for adjusting the low pass filtering.

Table 1 gives the modification in capacitor values required. Please **don't** be tempted to use 'near' values depending on what your junk box holds, use close tolerance silver mica or ceramic plate capacitors of the exact value unless of course you use tubular ceramics as originally fitted. Note that some capacitors require changing, where others require an extra capacitor added across the original one.

You will need to remove the internal board to carry out the changes. When removing the three central screws securing the main heatsink block to the chassis, take care not to break the 1nF decoupling capacitors fitted on the solder tags. You will also have to disconnect the RF input and output leads, but the board may still be hinged out if you leave the DC power wiring connected. Watch out for the heatsink compound smeared on the underside, it's terrible stuff to get off your clothes. After these capacitor changes, all further work may be performed from the component side of the board so you can do the screws back up to keep the compound away from fingers etc. Don't forget to resolder the RF input and output links.

Amplifier Mods

The Smith Chart came out at this point, and the delights of j-notation were yet again contemplated together with the transistor manufacturer's data. Then came the soldering iron and the inevitable 'final touches' (fiddles?) were added — why couldn't it be like the low pass filter?

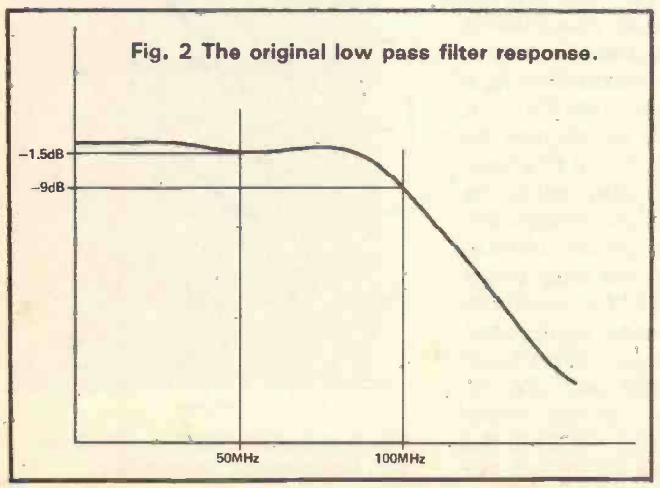


Fig. 2 The original low pass filter response.

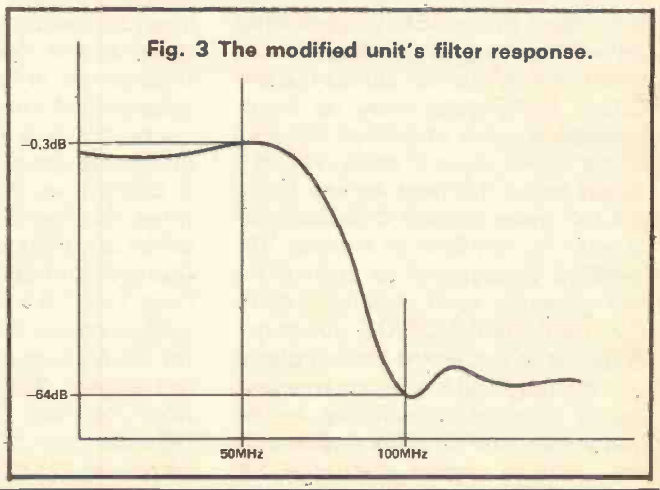


Fig. 3 The modified unit's filter response.

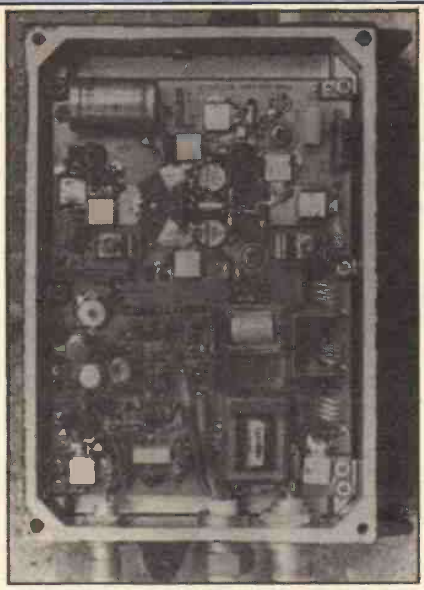
Both input and output impedances were more inductive with a decrease in frequency, so more capacitance to earth was required if I wished again to keep the existing inductors. This time, most types of capacitors may be used, values not being too critical, but ensure you use the shortest lead lengths possible. This is particularly true in the case of the added capacitors across C12, I found several in parallel to be the best. If you are feeling extravagant, Cirkit supply Semco mica-wrapped capacitors that are ideal for this use — you will see this type of capacitor already used on the input and output stages.

Across C12 you may see a silver mica 180pF capacitor added. This is used on manufacture when the amplifier is tuned below 78MHz. On later models with a flying input lead as opposed to input chassis-mounted socket, you will see a variable capacitance trimmer of 30-140pF. You will need a total of around 750pF extra, if the 180pF capacitor is fitted then subtract that, and if the trimmer is fitted set that to maximum (adjuster screwed tight) and subtract 140pF. Otherwise, four 180pF capacitors in parallel are ideal, soldered between the board earth plane and the input matching network board as shown in Fig. 1. The two other capacitors required are soldered between the 'hot' side connections of the trimmers and the board earth plane. Make sure you use a hot soldering iron to avoid dry joints here.

Switching Changes

As the amplifier is made for two-way AM/FM use, immediately the RF input power falls, the relays go back to their 'straight through' positions. If we want to use SSB, this would be rather annoying. By adding a small electrolytic capacitor across C2 and C3, a Tx/Rx delay may be incorporated. A value of 0.68uF will give about 0.75 second delay which I found to be the best for my taste, 0.47uF gives around 0.5s and 1uF around 1s. Any type of at least 10V working voltage will be suffice. Fit the capacitor with positive lead to D2 cathode/R3/C2/C3 junction, negative to the board ground plane.

You may find it useful to increase the RF switching sensitivity. As the unit stands, the amplifier switches in only with in excess of around 1W



drive power which could cause the loss of the first syllable or so of speech. Fit a small capacitor of around 4.7pF in parallel with the C1 (1pF) capacitor as this will increase the sensitivity to allow switching with about 50mW of 50MHz. Both of these capacitors may easily be fitted on the component side of the board.

Check that link 1 between pins 2 and 3, and link 2 between pins 4 and 5 are in place. You may then switch the amplifier in and out of circuit simply by switching the supply on and off. Alternatively, if you prefer to use a smaller toggle switch, connect it between the green/yellow supply lead and negative supply and unsolder both links 1 and 2.

Tune for Maximum Smoke

All that now remains to be done is a quick tune-up. Initially set C7 for minimum capacitance (vanes fully apart). Connect 13.8V DC and RF input and output leads, your 50MHz driver to the input, and the output through an in-line wattmeter to a suitable load. On early units the input connector is a TNC which may be difficult to get plugs for, in this case a flying coax lead may easily be fitted. Set your rig to give around 2W or so of constant power output, transmit and check the relay clicks over. Tune C8 and C17 for maximum output power, retuning as required for absolute maximum. You should get around 35W out with 2W in. Now connect your in-line meter between the 50MHz rig and the amplifier, and retune C8 slightly for the lowest input SWR — this will coincide with maximum output power from the amplifier.

If you are limited to less than 3W maximum power from your rig, leave C7 alone. If you can run up to 10W drive, then set C7 to maximum capacitance (vanes fully meshed), transmit your maximum power and tune C7 until you note the output power has fallen by around 10%. This will ensure you are not overdriving the amplifier. You may find that you need to very slightly readjust C8 again to give the best input match to your rig.

Don't try to squeeze the last watt out if you intend to use SSB, you will degrade the linearity resulting in audio distortion and splattering of your signal. For FM and CW use however, you will be safe with around 60W or so output with 10W input. I would not recommend using more than 10W drive power. If your set or transverter gives more, reduce the input level to 10W PEP maximum by applying suitable ALC, or by reducing the 28MHz or 144MHz drive when using a transverter.

Results

A number of A200s, of both new and old models, have been modified by myself and typical results and graphs are shown in **Table 2** and **Figs. 4** and **5** of the performance achieved. The output two tone intermodulation distortion with 2.5W PEP applied from a high

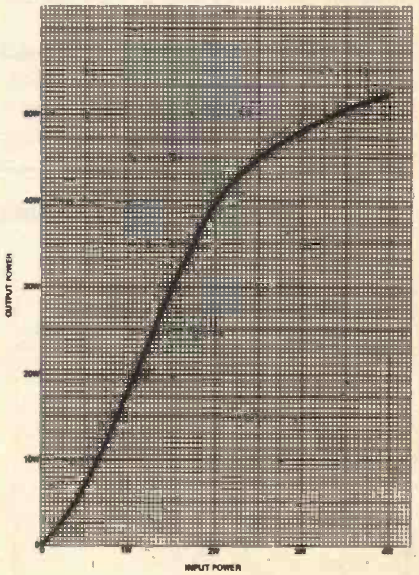


Fig. 4 A typical A200 modified for 6m, input/output relationship.

Table 2 The typical results achieved from a converted amplifier.

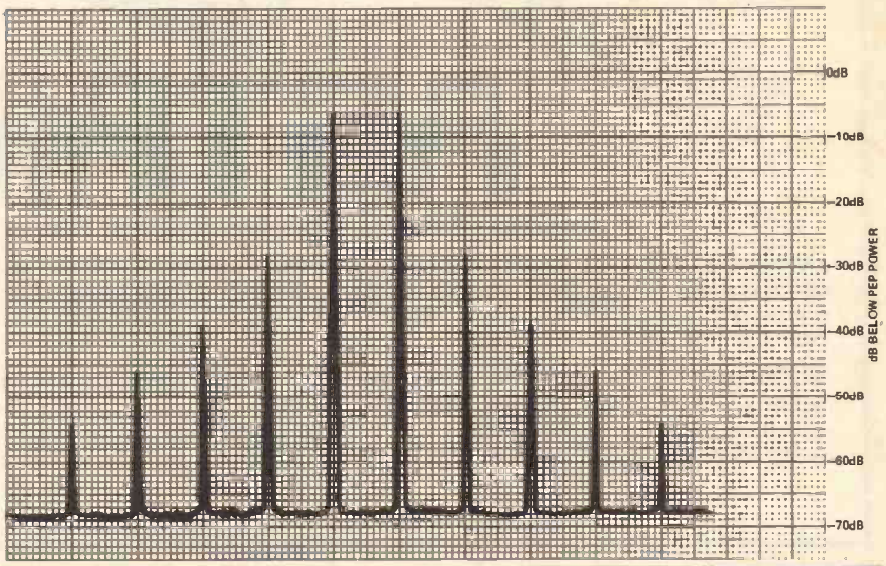
All tests performed at 50.25MHz unless stated.

Input/Output Relationship, sensitivity at maximum		
Power Input	Power Output	DC Current Drawn
0.5W	6.5W	2.1A
1.0W	17.5W	3.5A
1.5W	29.0W	4.3A
2.0W	39.5W	5.0A
2.5W	44.5W	5.6A
3.0W	48.0W	6.3A

Harmonic Output with 2.5W in, 44.5W out	
2nd Harmonic	−81dBc
3rd Harmonic	−90dBc
All others	<−90dBc

Straight Through Insertion Loss	Less than 0.5dB
RF Switching Sensitivity	Less than 100mW

Fig. 5 The intermodulation distortion of a typical, 6m A200 with two signals at 50.2 and 50.3MHz.



quality laboratory source is better than that from a typical drive signal such as the FT690, or IC505 on mid power so you should not get any degradation in signal quality in these cases. Conversely, the output 2nd harmonic level will be substantially better than that of a typical drive source even though you are putting out more 50MHz signal, due to the good low pass filtering in the amplifier.

You now have a good 6m amplifier to get your signal heard. Make sure that your power supply can stand the extra current demand. Finally, if you can't find an EO band unit, remember when rummaging on the rally stand that an AO or BO one will work just as well on 2m!